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8.012 Physics I: Classical Mechanics  
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## USEFUL EQUATIONS

Trajectory for constant acceleration  $\vec{a}$

$$\vec{r}(t) = \frac{1}{2}\vec{a}t^2 + \vec{v}(0)t + \vec{r}(0)$$

Velocity in polar coordinates

$$\frac{d\vec{r}}{dt} = \dot{\vec{r}} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta}$$

Acceleration in polar coordinates

$$\frac{d^2\vec{r}}{dt^2} = \ddot{\vec{r}} = (\ddot{r} - r\dot{\theta}^2)\hat{r} + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\hat{\theta}$$

Taylor expansion of function  $f(x)$ :

$$f(x) = f(a) + \frac{1}{1!}\left.\frac{df}{dx}\right|_a(x-a) + \frac{1}{2!}\left.\frac{d^2f}{dx^2}\right|_a(x-a)^2 + \dots$$